A LECTURE

-- ON --

Physical Training and Gymnastic Exercise,

Delivered to

The Naval Cadets at Annapolis, Md.,

— BY —

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ROYAL INNS OF ENGLAND
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ON EXERCISE.

General Remarks.

Gentlemen :

There is a perfect type of man, and the tendency of the race is to attain this type.

The order of growth is regular towards this type.

The variations from this type follow a certain definite law, the law of accidental causes.

The line formed by these variations, as made out by anthropometric measurements. when arranged in groups, receding on either side of their mean, is the curve well known to mathematicians as the binomial; it was first applied by Newton and Pascal to questions of astronomy and physics, but it is applicable to all the qualities of man that can be represented by numbers.

These conclusions have been arrived at by the most eminent investigators in the field of anthropometry and may safely be declared well established facts. In accordance with these conclusions the end and object of the education of the physical man are already defined. Aid nature in its tendency towards developing a perfect type and antagonize or remove those accidental causes which constantly but surely impede its progress towards this type. In this manner only can the evolution of the perfect man be materially abridged and every new generation be made an improved and revised edition of the old.

These conclusions, however, imply much more than this. Let us, therefore, begin at the beginning and examine for a moment some of the laws of growth and development. According to these, the frame of every individual has its ultimate size, shape and capacity determined from the commencement of its organization—bears within itself the germ of its perfectibility; but to this it will only attain when the laws and agents which regulate and support its growth and development are faithfully observed and duly administered.

The first part of the process of development has already been accomplished at birth, each organ and limb having its destined relative size, shape and position and function assigned; but the second part, the bringing of each of these to its completion, remains to be accomplished. The ultimate development however, is an essentially different operation from the first. The one being the unfolding, as it were, of the several structures from an original germ by laws of which we have at present but an imperfect knowledge while the latter consists in the adding to and the consolidation of these by agents with which we are daily becoming better acquainted. It is this second or ultimate stage which will form the subject of this evening's discourse.

Exercise alone, of all the agents of growth and development can be regarded in an educational light—alone is capable of being permanently systematized and administered as a means of progressive bodily culture during the greater part of the period of growth and development. In a discourse on physical education, therefore, exercise claims the most important place, because it is so much liable to be misunderstood, misapplied or neglected than any of the others. Air, food and clothing are all, in a measure, familiar to every one, and where error in their application is committed, it is usually either from some inevitable cause of hindrance, or from wilful infringement of laws of which ignorance cannot be pleaded. The insufficiently fed knows well that it would be better for him, and for those for whom he has to provide, to have abundance of nourishing food; but his poverty determines for him his diet. On the other hand, the intemperate needs no other reminder than the bodily discomforts he experiences to know that by him one of the agents of health has been abused and its laws broken: he was conscious of its fault on its committal—the penalty also was foreseen. But this is not the case with exercise; in its nature and influence this is still greatly misunderstood, and although the evils which arise from its abuse or misapplication are really as direct and as serious as those which follow the non-observance or misapprehension of any other agent of health, their origin is often less apparent, and they follow less suddenly on the committal of the fault: the punishment is as sure and as severe, but not always as clearly traceable to the transgression. Error here in a great majority of cases, may arise from actual want of knowledge. Persons of the most opposite bodily condition and capacity will without question or consideration, undertake the same physical exertion, although to one the effort may be slight, to the other exhaustion irretrievable. A vague feeling may be entertained that exercise is a thing to be taken, but to what extent, at what time, or in what manner, are points upon which few really consider it necessary to possess any adequate information, and the Cadets of this Academy form no exception to this rule. For want of exercise, appetite fails—for want of exercise, comfortable bodily warmth is not sustained—for want of exercise, refreshing sleep is not obtained—but these, reminders though they be, come indirectly and, as it were, incidentally only. They speak not with the imperative voice of hunger and thirst, or cold, or oppressive heat, or fatigue.

The infringement of this principle, that exercise should be "regulated by individual fitness, as ascertained by previous examination, that it should be approached gradually, and increased only with increasing strength," has been the cause of much perplexity and suffering. Scarcely a Summer passes without our attention being called to various victims of its transgression—someone who has escaped suddenly from his desk or study and, without preparation, or gradation or precaution of any kind or degree, has betaken himself to mountain, climbing, shooting, boating, or some other exciting pursuit, only to break down in the effort, or to struggle through it and sink down for many a month and day after it, his powers overtasked, his energies exhausted.

What then, let us ask ourselves, is exercise? What does it do? and, How does it do?

Exercise may be defined as muscular movements produced by muscular contraction by which indeed every motion of the living organism is acomplished. This property of contractility with which muscular fibre is endowed, and which so far as we know, is shared by no other constituent of the body, is to some described in the term—being the power of contracting or shortening the space between its two extremities.

The entire muscular system has been primarily divided into *voluntary* and *involuntary* muscles. The first, comprising all those which are subject to the will, form the bulk of the muscular system; they are mainly distributed over the frame-work of the bones, their office being to move the part or parts to which they are attached. The second, or involuntary muscles, comprise those over which the will has little or no control; these are placed within the cavities of the body and are employed in the vital processes of respiration, digestion, circulation, etc.

Our attention in these general remarks, will be engaged with voluntary muscles more particularly.

Exercise has been defined as muscular movement, but it must be movement of force sufficient to engage the energetic contraction of the muscles employed. Here we are touching upon the most important principle in the entire subject under consideration, namely, the destruction and renovation of the tissues of the body which it is the object of the exercise to accomplish.

Our material frame is composed of innumerable atoms, and each separate and individual atom has its birth, life and death and then its removal from the place of the living. Each atom preserves its vitality for a limited space only, is then separated from the tissue of which it has formed a part to be in due course eliminated from the body by the organs of excretion. These processes are greatly influenced by the activity of the bodily functions. Every operation of the muscles or nerves involves the disintegration and death of a certain part of their substance. We cannot lift a finger, nor make the slightest movement without causing a change in certain of the atoms which compose the muscles executing the movements, in those of the nerves conveying the stimulus which directed them to contract and in those composing the nerve-center in which the stimulus originates: and this change involves their decay and death.

The loss then of the body, and of each part of the body, being in relation to its activity, a second process is necessary to replace the loss, otherwise it would rapidly diminish in size and strength and life itself would shortly cease. This repairative process is performed by the nutritive system, the organs of which convert our food into blood which in itself contains the material for the replacement of all waste and for the building up of all the additions; and as this material is borne along through channels permeating every part of the organism, each part, by a law incomprehensible, but unerring, selects from it and appropriates that particular pabulum which is fit for its special use and that only. As the disintegration of any part is hastened by its activity, so by an equally unerring law, is the flow of blood, bearing the renewing material, increased in that part. And, during the period of growth, and, within certain limits, until the full at-

tainable physical capacity of the individual is reached, the new will ever exceed the old, so that a gradual increase in bulk and power will be attained; and the strength of the body as a whole and of each part of the body individually is ever in relation to the frequency with which these atoms are changed in other words, their *newness*.

Such, in general terms, is exercise, such the ends which it accomplishes; in doing this, it attains three distinct but correlative results:

1. It increases the size and power of the voluntary muscles employed.

2. It increases the functional capacity of the involuntary muscles employed.

3. It promotes the health and strength of the whole body by increasing respiration and by quickening circulation,

Health and strength then being the outcome of exercise, any system or plan of education which fails to provide for the proper development of the human body is incomplete, vicious and faulty.

Spinal curvatures, weak backs, chicken-breasts, ungraceful gaits, in many instances, are the result of inattention to gymnastic exercises. A muscle which is permanently unused degenerates and finally is entirely absorbed and disappears. This is well seen in cases of paralysis dependent on injury to the nerves which preside over the movements of certain groups of muscles. In such cases the muscles, at first perfectly healthy, but, being unused for a certain period, owing to the fact that no voluntary stimulus is carried to them, their connection between the will and muscular apparatus being broken, degenerate. It will be found that, even after the nerve-injury has been overcome and the nerve has regained its conducting power, the muscle has lost its functional activity. This is why physicians apply to such muscles electricity direct and induce artificial contractions until the nerve-injury is repaired.

Violent exercise should never be undertaken suddenly by any one not prepared for such exercise.

Muscular effort greatly increases the work of the heart not only because more blood has to be sent to the muscles at work, but they also produce in turn much greater quantities of carbon dioxide which must be carried off in the blood to the lungs for removal from the body. Consequently the heart is called upon to pump more blood through the lungs as well. The evil results of throwing violent exercise on the heart suddenly are found in diseases of that organ and the lungs.

Let us consider seriatim the physiological effects of exercise on the different organs of the human body. We will begin with (1) The lungs:—Many of you will have noticed that every muscular exertion is involuntarily preceded by an increased number of inhalations. Nature thus providing an increased supply of oxygen to substitute that which is used up by the muscular contraction; in other words exercise induces respiration and increases both the number of respirations and the depth of each act at respiration. The quantities of carbon dioxide and waste which are inhaled by the lungs are very much greater during exercise than they are during rest. Thus, it has been found that, if the quanity of air inhaled in the lying position is taken as a unit (=1) the quantity of air inhaled in the sitting position would be 1.18; in the standing position 1.33; while walking

one hour a mile 1.90; walking four miles an hour 5.00, and walking six miles an hour 700; or, as stated in other words, if a man at rest inhales 480 cubic inches of air per minute while walking four miles an hour he inhales 2,400 cubic inches, and while running 6 miles an hour 3,360 cubic inches. The carbon dioxide exhaled of course is in proportion also increased.

Both the active muscle and the one at rest absorb oxygen and give off carbon dixoide the absorption of oxygen and exhalation of carbon dioxide in the contracting muscles being about twice as great as in the resting one. If the carbon dioxide formed during muscular activity, were not rapidly carried off by the blood flowing through the muscle and eliminated from the body through the lungs, the muscles would become quickly fatigued and finally altogether unable to perform any work. It has been proven by experiment that, if the pulmonary circulation and, consequently, the exhalation of carbon dioxide be impeded, muscular exertion soon becomes an absolute impossibility. In order, then to insure the proper elimination of carbon dioxide from the body, it is necessary that exercise take place; and when it cannot the supply of carboniferous food must at least be lessened if the body is to remain healthy.

Although the act of respiration, under ordinary circumstances, is an almost entirely involuntary performance, it can, to a certain extent, be controlled by the will. Thus, we find in every act of volition, that respiration is hastened, whether the act be physical or psychical. Respiration is also influenced by temperature the respiratory act becoming deeper in the same degree as the body loses heat and vice versa: the temperature of the body will rise in the same proportions as the respirations become deeper.

Since oxygen is one of the chief power producing elements in the body, it can be said that, to be strong—capable of doing much work—a good breathing capacity is of far greater value than muscular strength inasmuch as breathing capacity gives and implies endurance or ability to persevere which is the keynote to success in the struggle of the survival of the fittest.

While properly guided, breathing exercises will develop and strengthen the breathing apparatus, careless and unphysiological exercises are bound to weaken the lungs and in time must induce diseases of the organs; excessive exercise of the lungs, that is, exercises carried beyond the capacity of endurance of a particular pair of lungs causes pulmonary congestion of and even hemorrhage from the lungs.

From these facts we gather the following rules which should be strictly observed during exercise:

1. The respiratory organs must be allowed perfect freedom of motion; no tight clothing should be used, and any exercise which compresses the chest or interferes with free respiration is to be avoided.

2. Since the elimination of carbon dioxide and the need of oxygen are so much increased during active exercise, the air should be as pure as possible. Hence, exercise out of doors is best: but if it has to be taken in doors, the room should be well ventilated, as far as possible kept from dust, and all over-crowding strictly guarded against.

3. The exercise should be so arranged as not to cause over-exertion, since the latter causes pulmonary congestion (a condition manifesting itself by deep sighing.) Hence when the exercises cause laborious breathing, rest should take place or, still better, such movements should be immediately used as will contract this condition (respiratory exercises, slow leg movement.)

4. Since the elimination of carbon is so much increased, those who exercise should partake of more carboniferous food best given in the form of the farinaceous vegetables and fat.

We must next consider the effects of exercise on (2) the blood and the circulatory organs:

The increase in color which shows itself in the skin of those engaged in exercise and the quickening of the pulse, show us that exercise influences the circulation. When a muscle contracts it exerts a pressure on those blood vessels which are located in and around it. The arteries have firm though elastic walls, and the blood within them flows forward with considerable pressure; furthermore the semilunar valves at the opening of the aorta prevent the arterial current from taking a backward direction: hence the arteries are but little affected by the pressure of the actively contracting muscle. The walls of the veins, on the other hand, are less firm and the elasticity of their coats is not a striking feature in them as it is in the arteries; neither is the pressure within the veins anything like as high as it must be in the arteries.

In the veins, the blood flows in the direction towards the heart, their numerous valves preventing the current from flowing in the opposite direction, and it follows, therefore, that the muscular pressure drives the venous current towards the heart with increased speed, squeezing, as it were, the venous blood out of the muscles. This process leaves the muscles with less blood in them after contraction than before contraction; the pressure in the arteries being increased during exercise, new arterial blood rushes into the muscles and this is repeated at every contraction and relaxation, more oxygen is carried to the muscles and more carbon dioxide carried out of them than during a state of muscular rest.

Every active movement increases the action of the heart which usually beats from ten to thirty times oftener per minute during exercise than normally. After exercise, the heart's action usually falls below the normal: after severe exercises the number of beats is reduced to 40 or 50 per minute. The diseases which may be caused by either excessive or deficient exercise are palpitation, hypertrophy, dilatation, fatty degeneration, etc. On the other hand properly guided exercises will tend to strengthen a weakened heart, and in such cases it would be a mistake not to make use of exercise as a therapeutic agent. It tends not only to strengthen the circulatory apparatus, but also to greatly improve the condition of the blood flowing through it. Osmosis is quickened and waste matters thoroughly and quickly carried out of the body through an increased activity of the excretory organs.

3. On the Digestive Organs: The contractions and relaxations of the diaphragm in the process of respiration, greatly influence the activity of the digestive organs. The peristaltic action of the intestine is increased and a more per-

fect digestion with a more rapid absorption are thereby induced. The circulation through the liver is quickened and also that through the alimentary canal. The consequences are that food is more perfectly digested, more quickly absorbed, and also that the faeces or the material which is of no use to the body, are more promptly and more thoroughly expelled.

4. On the Skin : During active exercise a certain amount of perspiration sets in, the skin is redder than normally, and more blood flows through the superficial blood vessels than during rest. The evaporation of this perspiration keeps the temperature of the body down at the normal; the temperature, however, will rise, if the pores of the skin be closed by dirt and free perspiration is thereby prevented. Under these circumstances exercise becomes burdensome, the breathing laborious because the extra amount of water which should be thrown out through the skin, must be got rid of through the lungs which soon suffer from over-work and over-taxation. After exertion, the bodily temperature quickly falls below the normal, while evaporation from the skin continues, and hence arises the danger of taking cold. It may seem singular at first, but it nevertheless is a matter of experience and observation that there is an intimate relation between exercise and cleanliness. Persons who take exercise regularly feel the necessity for cleanliness much more keenly than those who do not. It is a fact familiar to all of us that in the days of Julius Caesar, Rome was the mistress of the world. We know, also, that such magnificent power was acquired by the ancient Romans on account of their being physically invincible. At this time, also, we find fourteen mammoth aqueducts carrying into the city an absolutely limitless quantity of the purest water supplied from the Sabine mountains fifty miles away. During this period of Roman supremacy we find the people, the masses of high and low degree actually revelling in the purest water, and whenever the Roman emperor wished to especially ingratiate himself with the populace, he would have the baths thrown open gratuitously, although the charge for a bath in those magnificent establishments was only $\frac{1}{4}$ of a cent in our money.

From the effects exercise has on the skin, we learn the following useful lessons: (1) Keep the skin clean. (2) Take exercise in a cool room, the temperature to be from 55° — 60° F. (3) The clothing to be worn during exercise should be light. (4) After exercise, thicker clothing should be put on in order to prevent the chilling of the body.

5. On the Kidneys. Under ordinary conditions of rest, all the nitrogenous products of waste are thrown out by the kidneys; during active exercise, however, part of this function is, temporarily at least, assumed by the lungs and the skin, and hence the kidneys get a little wholesome rest. According to experiments made with regard to this point, it has been ascertained that during and after violent exercise, the total amounts of solid residue and urea are much diminished in the urine. On the other hand, lack of exercise decidedly lessens the activity of the skin and the lungs and consequently forces the kidneys to excrete more than their share of waste material, and by so doing these organs may become seriously diseased.

6. On the Organs of Locomotion. The greatest and, at the same time, most important changes going on during exercise are observed in the muscles. It is in them that nature develops power, storing it up during the resting stage and setting it free whenever the muscles are called into action either through an internal stimulus, such as the will or through an external stimulus, as danger from attack. If you should touch living muscles with a piece of litmus paper during rest, you would find its substance reacting neutral; during exercise, it reacts alkaline, and after very prolonged exercise, it might react even slightly acid. During exercise of the muscle, a large amount of CO_2 is produced; it is in fact in the muscles where most of the carbonic acid exhaled by the lungs, is produced. The venous blood coming from an actively contracting muscle is blacker than that coming from one not contracting; such blood is richer in carbonic acid and poor in oxygen; hence, also, the increased demands on the lungs by the muscles for more oxygen during exercise to which the system very promptly answers by an increased number of respirations in a given time. The natural result of these changes is the growth of the muscle and the bones as well, for we cannot very well increase the circulation in the muscles without also similarly effecting the bones that carry these muscles. Very considerable growth of bones on exercise has been observed in men 36 years of age by Maclaren of the University of Oxford, England. Unused muscles, on the other hand, must diminish in size and strength, and finally disappear altogether, nature having no sort of use for them, entirely eliminates them.

Too much exercise also affects the muscles injuriously inasmuch as it causes weakness instead of strength, and diminution in volume instead of increase. Hence exercise should be taken advisedly and with discretion.

Good food and the best of air are of course of fundamental importance. The muscles become quickly fatigued as soon as the supply of oxygen becomes insufficient, contractions taking place at longer intervals and becoming slower; the accumulation of acids in the muscles causes their complete exhaustion.

All exercises to be of value to the individual taking it must be taken on physiological principles; all the conditions, having a bearing on the general health, must be taken into account and it is no uncommon observation to see two individuals taking exactly the same exercise, one of which will go down in the scale of general health, the other will go up on account of the one doing his exercises in accordance with physiological principles; the former on the contrary, being ignorant and consequently regardless of the principles.

We must recognize, however, several important facts, namely: (1) That there is a limit to muscular development in the case of every individual consistent with the health of that individual, and consequently, exercises should be so adjusted as not to develop one part of the body at the expense of the other, which would be at the expense of general health. (2) The main object of all exercise must be the symmetrical development of the muscles of the individual and the harmonious working of all the organs concerned. (3) That during exercise, there should be an unlimited supply of oxygen in the form of pure air supplied to the individual taking it. (4) The diet during the intervals of exercise should consist in food rich in nitrogen. (5) Good physical development can

only come from exercise taken in accordance with the principles underlying general health.

(7) We shall have to consider the influence of exercise on the nervous system, mind and morals. It is a well established fact that all voluntary exercise is controlled by the brain and that we cannot exercise any group of muscles without also, at the same time, calling into action those nerve-centres which preside over the movements of that particular group of muscles. The benefit derived from exercise extends therefore, also to the brain and spinal cord. The nutritive conditions of these tissues are improved; the blood is made to flow more vigorously through their substance; their functions are exalted and strengthened and the entire nervous system is raised to a higher state of efficiency. Most of the so-called nervousness in people leading a sedentary life, more especially in women is caused by the lack of exercise and the nerves as well as the muscles become the seat of degenerative changes and diseases when the exercise is neglected. A good gymnast, taking regular exercise in accordance with physiological principles, is bound to be a good brain worker and will in due time gain the lead over his more negligent competitors with regard to his studies. It is a most mistaken idea that muscular work will impair mental work. If athletes are stupid, it is because they make no effort towards mental cultivation and not because exercise lessens their powers in this direction. A good, strong, and vigorous sound mind can find room only in a strong, vigorous and sound body. The influence of exercise upon the moral nature of man can scarcely be overestimated for vice is most often found associated with a lowered state of health and consequent morbidity of mind and intellect. It is the weak that fill our jails and reformatory institutions and not those who are strong in mind and in body. The habit of drinking strong drinks, in most cases, is acquired by reason of a diseased condition of the nervous system. The drunkard craves not the drink so much as he does its effects which are an exalted state of mind which in him, only, drink can produce but which in the healthy man exercise alone is quite sufficient in bringing about. Every one of you, no doubt, has experienced the stimulating and pleasurable effects of healthful exercise. But, from whatever point of view we may study the habits of the drunkard, our studies will always result in finding a disordered, more or less, unhealthy body at the bottom of such habits. For this reason, also, all the laws which have been passed forbidding the taking of strong drinks, have been ineffectual. There is just as little sound sense in such a law as there would be in one prohibiting the contracting of smallpox or measles. When a healthy individual is thirsty it is water it most desires to gratify its thirst with; thirst in a drunkard demands whisky. In both cases the desire under certain circumstances becomes so strong that no effort of the will is powerful enough to resist it. In the healthy person, thirst is the natural desire for one of nature's fluids to supply a most natural want. In the drunkard it is a morbid craving for an artifical product to bring about that condition of well-being, temporarily at least, which water alone cannot bring about, owing to the unbalanced physical and mental condition of the individual. As long as rye and barley must grow, no goverment whatever its form, can succeed in controlling the manufacture of liquors any more than it can the growth

and multiplication of disease-producing microbes, by laws passed by the legislature which simply prohibit the sale of these things. The normal physical development of its individuals and based upon their moral education alone can ever decrease their demands.

It should always be primarily remembered, that intellection and ethics, mind and morals are the susperstruction which has the body for its foundation. The plan of the edifice may be comprehensive and imposing, but its stability and soundness will depend upon the enduring and resistive power of its foundation. This means sound physical development according to physiological principles, the results of which will be corporal excellence, the integrity of the various organs of the body, their mental and proper adjustments to the varying conditions of each other and the maintaining of their reciprocal and symmetrical relations.

Physical training, therefore, as a pedagogic measure, is not only equal to mental training, but, rightly considered, should take precedence over the latter. It used to be the case that the development of the body received attention before the mind, but the clergy were adverse to physical education and the scholastic system introduced by them excluded bodily exercises altogether, and thus it happened that the custom prevailed to first cultivate the mind and afterwards repair the damages done to the body. It is only in some of our best and, therefore, deservedly leading colleges and universities in which the educational pendulum would seem to swing back to the heathen custom of training the body as well as the mind in the now firm and well established belief that physical excellence determines beyond question the quality and capacity of the intellect. In the Naval Academy there should be a strong department of this kind; it should lead instead of follow the colleges of the country. In its relation to the Navy in general, the Naval Academy should be in this respect as in any other, what the heart is to the human body—the centre and source of its vitality and physical power, the spot through which and from which its life-blood flows, from which is distributed to every spot, near and far, the young, fresh, bright stream to strengthen, to revivify and to renew. Those who have paid little or no attention to the subject can have no idea of the comprehensiveness of the plans and the importance of supervised and systematized physical eduation as carried out in our leading colleges and universities. In Harvard and Cornell a special selective course has been drawn up, comprising four years and leading up to the degree of B. A. and B. S., and intended to produce professors of physical culture. At the Naval Academy, still greater importance should be attached to this department than is now done in universities from the essentially military character of the institution, and it is among the men who pass through such institutions that we are, quite naturally, led to look for the finest specimens of manhood.

And if, at last, a beginning has been made to develop and train the latent physical talents and resources of the Naval Cadet according to the best and, scientifically, most approved methods, the success of the undertaking, while it always must remain proportionate to the amount of interest and intelligent appreciation of the Cadets themselves, will, I think, always be distinctly traceable to two fortunate circumstances, namely: 1. To an appreciative, strong and

far-sighted Superintendent who recognizes plainly the two-fold character of the trust at all times imposed upon the head of an institution of this kind, which is: The mental as well as physical training and the general health of his trust, and 2. To the formation of the Auxiliary Athletic Association, at all times prepared and ready to lend a helping hand in many ways.

It is in the gymnasium alone where we can prepare you for the successful struggle with the privations, hardships and the duties of the life which you have chosen, and military gymnastics are the root whence all other kinds of gymnastics sprang. Training by gymnastics is not a product of modern times for, long before physicians, teachers and statesmen had availed themselves of the advantages of gymnastic training, they were practiced by the barbarian and, through all ages, up to the present time, they have remained one of the chief means of attaining military excellence. The experience on the battle field has gone far to prove, and all military authorities are unanimous in pronouncing bodily culture as the true foundation of military excellence.

The brightest pages in the history of the ancient Greeks and Romans date from the times during which they paid equal attention to both physical and mental training. Among the Greeks, competitions in manly exercise formed a principle feature of the many popular festivals amongst which those of Olympia were the most celebrated.

Amongst the Romans gymnastics never enjoyed the same reputation as amongst the Greeks. Their soldiers, indeed learned to swim, to leap, to run, to fence and throw the lance because these things proved profitable in the field, but gymnastics proper, at no time, formed a branch of public education. Their public games, too, lacked the refinement of those of Greece and instead of the manly competitions of Olympia, we meet with the barbarous and bloodthirsty contests of gladiators.

But we know, furthermore, that just as their gymnasia crumbled into ruins, their physical prowess forsook them both and their intellectual accomplishments were things of the past—"Footprints on the sands of Time." There is then, the most vital bond of connection between the physical and the intellectual development of nations traceable all through history and it is as true to-day as it was then that a country to be invincible in the struggle with other nations, must be physically so to begin with the physical resources of her individuals, in other words, must be developed first of all, for the history of the struggle between nations has sufficiently proven beyond all doubt, that it is primarily the physically fittest, that will survive.

What will become of the stream, if we allow its springs and fountains to die out?

But we need not go back as far as the ancient Greeks and Romans in order to find examples illustrating the advantages to be derived from systematic gymnastic training for a people.

Modern history, also, has furnished some very striking examples e. g. The early part of the present century found the German people bowed down under the yoke of the armies of Napoleon. By many of her patriots the true cause of

the national calamity was quickely recognized. Accordingly, in 1811 we find F. L. Jahn opening the first public gymnasium near Berlin, plainly recognizing the fact that the first and foremost duty to be performed by way of regenerating a people, is to begin by the proper and systematic development of the physical resources of her individuals. Jahn's efforts were successful only after many severe trials; Jahn himself was imprisoned owing to fabricated charges brought against him by an infuriated and narrow minded clergy. He lived, however to see gymnastics regularly introduced into the schools by Royal Decree in 1842 and gymnasia began to flourish all through Germany. Directly in the wake of the physical development of the German people we also find increased intellectual development.

Need I remind you of the experiment which occurred but 21 years ago, and which promptly demonstrated to the world most conclusively the military excellence of the German army, the education of which is based upon bodily culture. But, while physical strength and intellectual development are the natural outcome of carefully graded and supervised gymnastic exercise, its greatest benefit is health. By the proper system of exercising applied during the period of physical development and growth, we can indeed not only ward off disease by making the body more resistent, but we can directly raise the standard of health of each individual by special exercise.

From this point of view, all exercise may be classed under two distinct heads, Recreative and Educational. The first of these embraces all our college games and pastimes which are more especially valued, for they mould the characters as well as the frames of our youths. But, valuable as these exercises are, they all have one great defect. Since skill and art are made the subjects of the first consideration in these games, health and strength, necessarily must take a position subordinate to these, the game itself being all in all. The parts of the body which have to execute the movements of such exercises are those which can do them best, not those which need employment most; we all like to do that which we can do well: and thus, inevitably, because based on the organic law of development being in relation to activity or employment, certain parts of the body will be cultivated and become developed to the exclusion of the others. So certain is this the case that it is as easy to tell from the general development of any youth what recreative exercise he has practised when at school as it is to tell from the conformation of the chest whether a man pulls on the bow or the stroke-side of his college boat. There is in other words, a development peculiar to the runner, jumper, wrestler, oarsman, ball-player, etc. For instance, relatively long limbs with a short body, full chest and small bones will characterize the typical short distance runner wherever he may be found. The long distance runner's common characteristics are, length of body and thighs, the great girth of chest and the regions just above the ninth rib. To these must be added the splendid heart and lung power, that accompany this peculiar formation of the body. In short distance runners and jumpers we need ability to make violent spasmodic efforts in addition to lasting and staying powers, and in such athletes we find the lung power developed over and above the lung capacity. Hence to those who pursue these games rigorously, gymnastic exercises must come in

as a corrective; they must be put through exercise adapted to bring into action those muscles which their particular pastime has left unemployed. The first and foremost object of all training must ever be a good breathing capacity, if we wish to attain that kind of strength that wears well. Proper breathing is the very corner stone of physical strength. We should become ever-mindful of the fact that breathing is not only to be practiced during breathing exercises but that it is essential to carry the practice of slow, deep and long breathing into our daily life and occupation. The kind of training that starts in to load certain parts of the body with hard muscles, overlooking the simplest elements of general health and strength, is an error which often proves more than a harmless mistake. The highest state of health and power in a muscle will always lie in its flexibility rather than its hardness. A man trained until his muscles feel "like iron" is really in a dangerous state. His muscles feed upon his vitality and threaten his general health. A man so "muscle-bound," as the saying goes, is not in possession of a power, but the power possesses him.

On the other hand a man who keeps his muscular system in a state of comparative softness and high flexibility, cannot only summon great strength, but his powers of endurance are perfectly surprising. Proper exercise will preserve his condition and he is at any time ready to train for special effort. Properly guided gymnastic exercise, then improves the human motor by giving to all its machinery a greater strength and ease of working. The chief object of physical culture must ever be the harmonic development of the human physique and the fashioning of the highest types of manhood and womanhood, their health in strength and strength in health, and not the training merely of athletes for special effort. The one great reason why systematized exercise is not always appreciated or recognized is that its special nature and object, its susceptibility of gradation to meet the requirements of individuals and its effects upon the different structures of the human frame, are imperfectly understood. Its effects upon any part but the muscular system are not taken into consideration; its vast influence over the other systems and especially on the organs employed on the vital processes of respiration, circulation and nutrition are seldom appreciated. The evils arising from this imperfect comprehension of an agent so important to the healthy growth and development of the young, are manifold and increasing—increasing in the ratio of man's intellectual advancement; because so long as it is believed that systematized exercises give only muscular power, few of those engaged in purely intellectual pursuits would care to cultivate it. But if it can be proved that this muscular power is but one result of systematized exercise, and that not its highest; if it can be shown that properly regulated exercise can be brought to bear directly upon the other systems of the body, and especially upon the delicate and important structures which encase and contain the vital organs and one whose fair and full development the health, strength and functional ability of these organs must greatly depend through life, then such exercise takes another rank, becomes as valuable to the man who works with his brain as to him who works with his hands, and will be sought for with a desire proportionate to his intelligence and knowledge of the subject, because it will enable him to prolong his labors with safety to himself and in-

creased value to his fellow men for many years. But, the greatest amount of this culture should be obtained in youth during the period of the body's growth, when every organ, and every limb, and every tissue and every bone are advancing to occupy their ultimate place and position—while all is plastic and moving, changing and capable of being changed. This is the time for all culture, mental and physical, especially the latter.

Get the strong limbs and shapely frame and a little, very little, will keep them so; get the strong heart and ample lungs, set in the fair proportioned and elastic chest and little, very little, additional effort will keep them so—not more than the busiest life can spare nor more than the gravest mind would seek for mental recreation and beguilement—a daily walk or ride, an occasional break into the country with gun or fishing rod or alpenstock.

A few words on *anthropometric measurements*: A distinguished philosopher very correctly remarks that the only true experimental observatiou of physical facts, is the proper and exact measurement of quantities. Anthropometry is nothing more nor less than this principle applied to the human body. The living human machine, through anthropometry speaks to us in certain fixed weights and measurements which have a meaning which is forcible and significant, and never misleading. A certain definite and unmistakable value is attached to every single measurement and test the sum total giving both the actual and potential strength of the individual as well as his vital capacity. It reveals deficiencies that were never suspected to exist before and leads the way toward their correction.

Anthropometric meaurements alone can give one the proper data upon which to base a special course of exercises. When we see weight increase at the expense of structure, chest girth increase at the expense of a decrease in circumference of the lower limbs; when we see the lower limbs enormously developed while the upper limbs and chest degenerate, and when we furthermore realize that such unbalanced development means disability and weakness rather than health and strength it is then that we begin to attach a very different meaning to physical training and the uecessity of proper and judicious supervision aided by exact anthropometric measurement. It is then also, that you will the better appreciate the meaning of the words of our poet and begin to

"Study yourselves; and most of all, note well
Wherein kind nature meant you to excel."

The following is a list of books and papers used and referred to in the preparation of the foregoing lecture :

1. Maclaren, Archibald--Training in Theory and Practice.
2. ———— A System of Physical Education.
3. ———— A System of Military Gymnastic Exercises.
4. Morgan, John Ed.—University Oars.
5. Blundell, John W. F.—The Muscles and their Story.
6. Ravenstein, G. E., and Hulley, John—A Handbook of Gymnastic Exercises and Athletics.
7. Wey, H. D., (M. D.)—Physical Training as a means of Mental Improvement.
8. Hartwell, E. M., (M. D., Ph. D.)—School Document, (Boston, Mass.)—No. II.
9. Seaver, Jay W., (M. D.)—Anthropometry and Physical Examination.
10. Sargent, D. A., (M. D.)—Physical Education in Colleges, North Am. Review, Febry., 1883.
11. ———— Physical Training—Am. Publ. Health Assoc., Nov., 1883.
12. ———— The Physical Proportions of the Typical Man—Scribners' Mag., July, 1887.
13. ———— The Physical Characteristics of the Athlete, ibid, Nov., 1887.
14. Checkley, Edwin—A Natural Method of Physical Training.
15. Thornton, John P.—Training for Health, Strength, Speed and Agility
16. Anderson, William G., (M. D.)—Light Gymnastics.
17. Enebuske, Claes J., (A. M., Hh. D.)—The Gymnastics Progression.
18. Posse, Baron Nils (M. G.)—Swedish System of Education Gymnastics.
19. Wey, Hamilton D., (M. D.)—Physical Training of Criminals. No. 3, Vol. I, Md. Education Assoc.
20. Betz, Carl—A System of Physical Culture.

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